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Application Documents for Review

File Name	Description	Page
ProjectNarrativeAttachments_1_2-Attachments-2019_2005820_Pierce_with_Sub1034095161.pdf	Attachment from Grants.gov	2
BudgetNarrativeAttachments_1_2-Attachments-Budget_Justification_with_sub1034095160.pdf	Attachment from Grants.gov	20
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Global Chemistry and Aerosol Predictions for Improved Predictions of Long Range Pollution Transport within FV3

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Requested Funding:

	Year 1	**Year 2**	**Year 3**
SSEC:	$186,165 (FY19)	$174,194 (FY20)	$174,411 (FY21)
CIRES:	$ 61,035 (FY19)	$ 74,763 (FY20)	$ 74,924 (FY21)
Total:	$247,200 (FY19)	$248,957 (FY20)	$249,335 (FY21)

Submitted to the Air Quality Research and Forecasting Competition
FY2019 Office of Weather and Air Quality Research Programs Funding Opportunity
NOAA-OAR-OWAQ-2019-2005820
Global Chemistry and Aerosol Predictions for Improved Predictions of Long Range Pollution Transport within FV3

19 December 2018

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NOAA Collaborators: Greg Frost (NOAA/ESRL/CSD), Georg Grell (NOAA/ESRL/GSD, Pius Lee (NOAA/ARL)

Abstract

This proposal addresses the Air Quality Research and Forecasting (AQRF) Priority 3: “Improved spatial and temporal estimates of anthropogenic and natural pollutant emissions, including wildfire smoke and dust and other potential sources of model biases, using NOAA satellite remote sensing and other data sources” and Priority 5: “Improved model representation in the FV3 model of physical/chemical processes for long range transport including lateral boundary conditions for regional models”. Under support from the FY17 NOAA Research Transition Acceleration Program (RTAP) we have implemented Real-time Air Quality Modeling System (RAQMS) full tropospheric/stratospheric chemistry into FV3 following the framework of the National Unified Operational Prediction Capability (NUOPC) coupler (FV3GFS-RAQMSCHEM). Collaborator Georg Grell leads the development of the aerosol component of FV3 (FV3GFS-GSDCHEM) which also follows the NUOPC coupling framework so these chemistry and aerosol components can be run simultaneously.

Under this proposal, we will update the RAQMSCHEM global anthropogenic, biogenic, and wildfire trace gas emissions to align with the aerosol emissions within GSDCHEM. Then, the combined FV3 chemistry and aerosol predictions will be used as lateral boundary conditions for retrospective air quality forecasts using the National Air Quality Forecast Capability Operational forecasting system (NAM-CMAQ). We will assess the impact of improved LBC on surface ozone and PM2.5 predictions using measurements from the US EPA AIRNow network and from measurements collected during the 2019 NASA/NOAA FIREX-AQ field campaign. Once these retrospective studies are completed we will focus on porting the RAQMSCHEM capability to ESRL, which is currently conducting real-time testing of the GSDCHEM aerosol predictions, so that real-time testing of the combined FV3 chemistry/aerosol forecasts can be evaluated and used for testing within the developmental version of NAM-CMAQ at ARL. Finally, we will work with NWS on transitioning the combined FV3 chemistry and aerosol forecasts into Operations at EMC.

The current technology Readiness Level of FV3GFS-RAQMSCHEM is 6 (potential demonstrated). We have tested the FV3GFS-RAQMSCHEM coupler through comparisons between FV3 chemistry forecasts and RAQMS chemical analyses and demonstrated good agreement in 5 day chemistry predictions. We have successfully ported and benchmarked the current developmental version of NAM-CMAQ and conducted experiments to assess the impact of LBCs from RAQMS chemical and GOCART aerosol analyses on NAM-CMAQ predictions, including development of procedures to map the RAQMS chemistry and GOCART aerosol species onto the NAM-CMAQ chemical mechanism. These tests were conducted on the Supercomputer for Satellite Simulations and Data Assimilation Studies (S4) at SSEC where the first year development and retrospective testing will be performed.

Statement of Work
(Project Duration: 3 Years)

1. Description of the proposed activities

Under this FY19 Office of Weather and Air Quality (OWAQ) research proposal combined FV3 chemistry and aerosol predictions will be harmonized by aligning anthropogenic, biogenic, and wildfire emissions, and then used as lateral boundary conditions (LBC) for retrospective air quality forecasts using the National Air Quality Forecast Capability (NAQFC) Operational forecasting system (NAM-CMAQ)[1]. Collaborator Georg Grell at ESRL leads the development of the National Unified Forecasting System (UFS) aerosol component, Greg Frost at ESRL leads the UFS emissions development, and collaborator Pius Lee at ARL leads the development of NAM-CMAQ. We will assess the impact of improved LBC on surface ozone and PM2.5 predictions using measurements from the US EPA AIRNow network (https://airnow.gov/) and measurements collected during the 2019 NASA/NOAA FIREX-AQ field campaign (https://www.esrl.noaa.gov/csd/projects/firex/science.html). Once these retrospective studies are completed and regional ozone and aerosol forecast improvement is demonstrated, we will focus on porting the atmospheric composition forecast capability to ESRL, which is currently conducting real-time testing of FV3 aerosol predictions (https://fim.noaa.gov/FV3chem/), so that real-time testing of the combined FV3 chemistry/aerosol forecasts can be evaluated and used for testing within the developmental version of NAM-CMAQ at ARL. Finally, we will work with the National Center for Environmental Prediction (NCEP) on transitioning the combined FV3 chemistry and aerosol forecasts into Operations through the Environmental Modeling Center (EMC).

1.1 Relevance to NOAA

Atmospheric composition predictive capabilities are explicitly called for in the Strategic Implementation Plan (SIP) for Evolution of Next Generation Global Prediction System (NGGPS) to UFS (https://www.weather.gov/media/sti/nggps/SIP-FY18-20-v4.pdf) as part of the suite of physical parameterizations, including the interaction of atmospheric composition with other physical parameterizations through radiative impacts and wet and dry deposition processes. The proposed activities address the Air Quality Research and Forecasting (AQRF) component of the FY2019 OWAQ Research Program by contributing to the development of the NGGPS Aerosol and Atmospheric Composition predictive capabilities. The proposed activities will specifically address AQRF Priority 3: "***Improved spatial and temporal estimates of anthropogenic and natural pollutant emissions, including wildfire smoke and dust and other potential sources of model biases, using NOAA satellite remote sensing and other data sources***" and AQRF Priority 5: "***Improved model representation in the FV3 model of physical/chemical processes for long range transport including lateral boundary conditions for regional models***". While not the primary focus of the proposed activities, the improved prediction of stratospheric ozone within NGGPS will also support the OWAQ Subseasonal to Seasonal (S2S) Priority 2 through "***development and evaluation of individual sub-elements within model components***" focusing on "***characterizing the component-to-component interactions***" via ozone radiative impacts on the FV3 dynamics.

1.2 Previous Results

The Real-time Air Quality Modeling System (RAQMS)[2,3,4] unified stratosphere/troposphere chemical module, along with aerosol predictions from the Goddard Chemistry Aerosol Radiation and Transport (GOCART)[5] module, has been used for daily real-time global trace gas and aerosol assimilation and forecasting since 2012 (http://raqms-ops.ssec.wisc.edu/). The RAQMS stratospheric chemistry module was originally developed as part of a coupled chemistry/dynamics general circulation model[6,7,8,9,10,11]. Stratospheric chemical predictions account for the standard stratospheric odd oxygen (Ox), hydrogen oxide (HOx), nitrogen oxide (NOx), chlorine oxide (ClOx) and bromine oxide (BrOx) reactions and have been verified with satellite, in-situ airborne, and remote balloon measurements[11,12,13]. The RAQMS non-methane hydrocarbon (NMHC) chemical scheme is based on the Carbon Bond-IV mechanism (CB-IV)[14] with semi-explicit treatment of propane and adjustments for background ozone production[15] including a four-product isoprene oxidation scheme. Tropospheric ozone production and loss processes have been verified with tropospheric airborne in-situ measurements[3]. RAQMS has been used to assess the impact of global chemical forecasts on regional air quality predictions[16,17]. These studies have demonstrated that RAQMS LBC lead to improved predictions of surface ozone and aerosols.

Under support from the NASA (ROSES 2013 Aura Science Team, NNH13ZDA001N A.17) we have used RAQMS, in conjunction with NOAA National Centers for Environmental Prediction (NCEP) Gridpoint Statistical Interpolation (GSI) analysis scheme, to conduct a multi-year (2006-2016) chemical and aerosol reanalysis using NASA Earth Observing System (EOS) satellite trace gas and aerosol retrievals. Figure 1 shows statistical comparisons between coincident RAQMS Aura Reanalysis and ozonesonde profiles at Trinidad Head, CA and South Pole. Median (50th percentile) and upper (75th and 95th) percentile RAQMS ozone profiles are in very good agreement with ozonesonde measurements throughout the profile at both sites. RAQMS tends to overestimate the lower (10th and 25th) percentiles of the observed ozone distribution in the upper troposphere (10-12km) at Trinidad Head and South Pole (5-10km). The RAQMS Aura Reanalysis also tends to overestimate ozone loss at 20km and underestimate ozone loss at 15km (lowest 10th and 25th percentiles) within the Antarctic ozone hole. Overall, these comparisons show that the RAQMS chemical mechanism is able to capture the observed ozone distributions fairly well. Comparisons at other sites (Huntsville, AL; Boulder, CO; and Greenland) show similar agreement, demonstrating that the RAQMS chemical mechanism is able to capture the day to day variability of the observed tropospheric and stratospheric ozone distribution to a fairly high degree of accuracy. This is critical for accurate predictions of long-range transport and stratosphere/troposphere exchange processes.

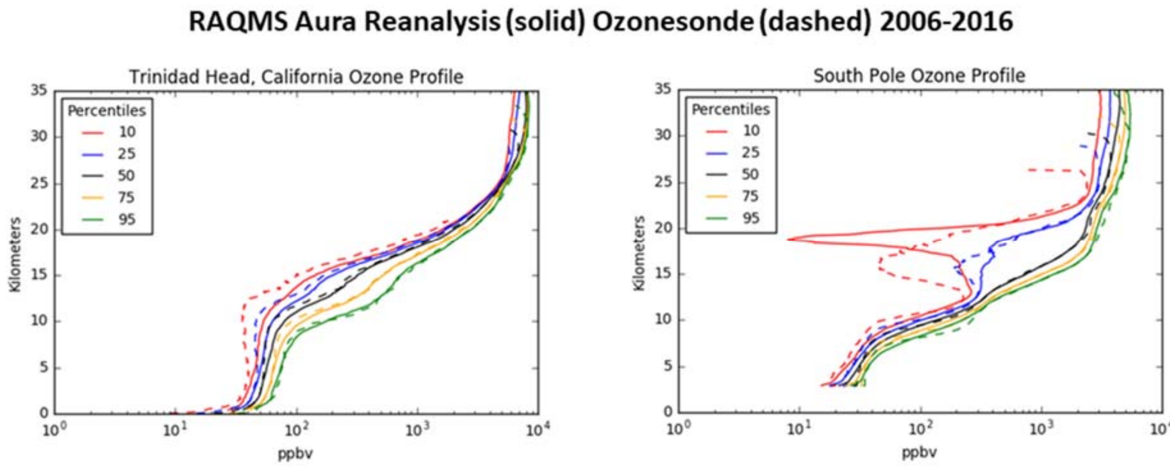

Figure 1: Comparison between coincident RAQMS (solid) and ozonesonde (dashed) at Trinidad Head, CA (left) and South Pole (right) for the period from 2006-2016. The median (50th percentile) ozone profiles are shown in black along with the lower 10th (red) and 25th (blue), and upper 75th (yellow) and 95th (green) percentiles.

Under support from the FY17 NOAA Research Transition Acceleration Program (RTAP) we have implemented RAQMS full tropospheric/stratospheric chemistry into FV3 following the framework of the National Unified Operational Prediction Capability (NUOPC) coupler (FV3GFS-RAQMSCHEM). Collaborator Georg Grell leads the development of the aerosol component of FV3 (FV3GFS-GSDCHEM) which is based on GOCART and also follows the NUOPC coupling framework so these chemistry and aerosol components can be run simultaneously. Figure 2 shows a comparison between 10-day ozone forecasts initialized at 00Z on September 29, 2016 for FV3GFS and FV3GFS-RAQMSCHEM. The forecasts used the C96 (approximately 1 degree) resolution FV3 dynamical core. Global ozone forecasts are shown on the 330K isentrope, which extends from the lower stratosphere at high latitudes to the mid troposphere in the tropics. Isentropic coordinates are best suited for examining long range pollution transport and stratosphere/troposphere exchange processes since the large scale flow follows isentropic surfaces[18]. The FV3GFS forecast was initialized using the FV3GFS ozone analysis and the FV3GFS-RAQMSCHEM was initialized using the 1x1 degree RAQMS Aura ozone reanalysis. The FV3GFS-RAQMSCHEM 330K ozone forecast is significantly higher than FV3GFS at high latitudes and generally shows lower ozone mixing ratios in mid-latitudes and regions tropical upwelling such as Indonesia. The ability to accurately capture upper tropospheric and mid tropospheric ozone is critical for accurate LBC for constraining regional air quality predictions and has the potential to significantly impact the UFS meteorological predictions due to ozone radiative forcing in the upper troposphere/lower stratosphere.

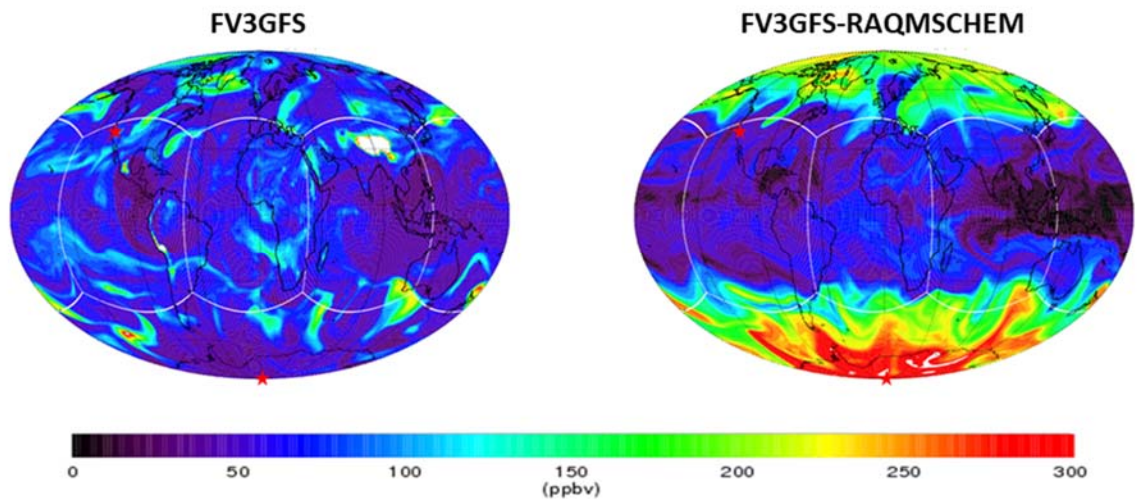

Figure 2: 10-day ozone forecasts valid at 00Z on October 09, 2016 for FV3GFS (left) and FV3GFS-RAQMSCHEM (right) on the 330K isentropic surface. The red stars denote the location of the Trinidad Head and South Pole ozonesonde locations.

Figure 3 shows comparisons between South Pole and Trinidad Head ozonesondes and FV3GFS and FV3GFS –RAQMSCHEM ozone forecasts at 21Z on October 07, 2016 and 17Z on October 06, 2016, respectively. At the South Pole station, the FV3GFS-RAQMSCHEM forecast is significantly higher than FV3GFS ozone forecast between 300-100mb resulting in much better agreement with the ozonesonde observations at 330K (the pressure of the 330K isentrope for each ozonesonde is shown). At the Trinidad Head station, the FV3GFS-RAQMSCHEM forecast is slightly higher and the FV3GFS forecast is slightly lower than the ozonesonde measurements on the 330K isentrope, but FV3GFS-RAQMS does a better job of capturing the pocket of low ozone in the middle troposphere. The FV3GFS-RAQMSCHEM ozone forecast is systematically higher than the FV3GFS forecast in the middle stratosphere (30-10mb), resulting in much better agreement with the stratospheric ozonesonde measurements at both sites.

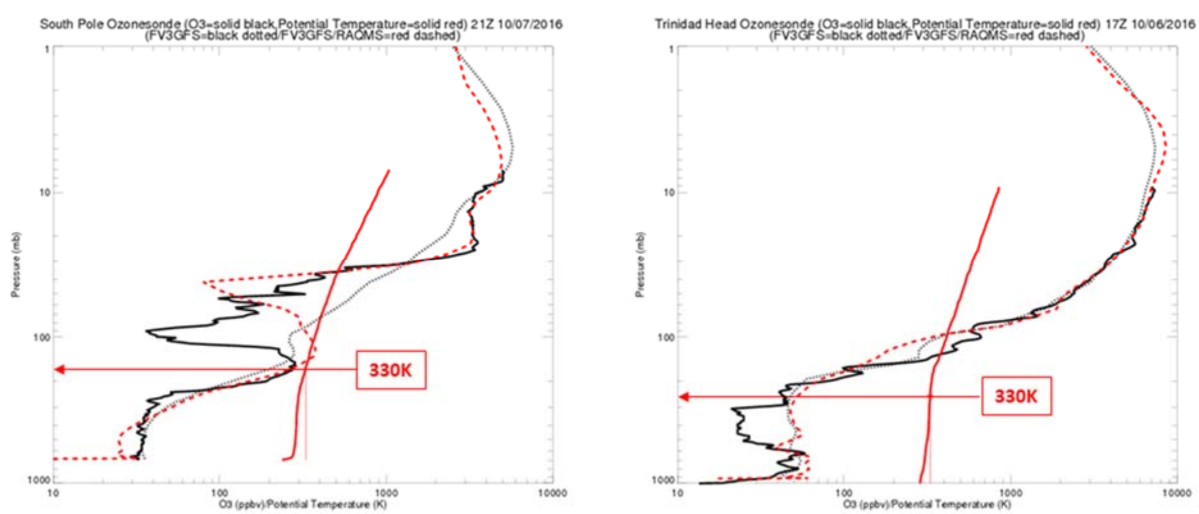

Figure3: Comparison between FV3GFS and FV3GFS-RAQMS ozone predictions and ozonesonde measurements at South Pole (left) at 21Z on October 07, 2016 and Trinidad Head (right) at 17Z on October 06, 2016. The observed ozone (black) and potential temperature (red) are shown as solid lines. The coincident FV3GFS (black dotted) and FV3GFS-RAQMS (red dashed) are also shown. The horizontal red line shows the pressure of the 330K isentrope.

1.3 Technical Readiness Level

The current technology Readiness Level of FV3GFS-RAQMSCHEM is 6 (Potential Demonstrated) and we anticipate reaching RL 8 (Demonstration) with parallel testing of the combined UFS aerosol and trace gas predictions at EMC at the end of the 3 year funding cycle. We have tested the FV3GFS-RAQMSCHEM coupler through comparisons between FV3 chemistry forecasts and RAQMS chemical analyses and demonstrated good agreement in 5 day chemistry predictions. We have successfully ported and benchmarked the current developmental version of NAM-CMAQ and conducted experiments to assess the impact of LBCs from RAQMS chemical and GOCART aerosol analyses on NAM-CMAQ predictions, including development of procedures to map the RAQMS chemistry and GOCART aerosol species onto the NAM-CMAQ chemical mechanism. These tests were conducted on the Supercomputer for Satellite Simulations and Data Assimilation Studies (S4) at SSEC where the first year development and retrospective testing will be performed. The S4 system is designed to facilitate accelerated research on satellite data assimilation (DA) applications and for integrating mature science into NOAA's operational assimilation and forecast modeling suite.

1.4 Work Plan

The first year of the proposed activities will focus on updating RAQMS anthropogenic, biogenic, and biomass burning emissions within the RAQMSCHEM NUOPC coupler to align with GSDCHEM aerosol emissions and evaluating the impacts of updated emission inventories on global composition forecasts. This will involve close collaboration with NOAA collaborator Greg Frost, who leads the UFS emissions development. The second year will include retrospective experiments to assess the impact of global composition and aerosol LBC on regional NAM-CMAQ forecasts and porting RAQMSCHEM to the ESRL High Performance Computing (HPC). This phase of the research will involve close collaboration with NOAA collaborators Pius Lee, who leads the development of NAM-CMAQ at ARL, and Georg Grell, who leads the development of the UFS aerosol forecasting. The third year will focus on real-time demonstration of the impact of global composition and aerosol LBC on parallel NAM-CMAQ regional forecasts and working with EMC on transitioning the combined FV3 aerosol and composition forecasting capabilities to Operations at NCEP. PI Pierce will be responsible for overall management of the proposal and supervision of a Post-Doctoral Student who will be involved in all phases of the research and mentored by PI Pierce and Co-I Lenzen at SSEC. Co-Is Lenzen and McKeen will be responsible for implementation and testing of the updated emission inventories during year 1 and will be responsible for porting and benchmarking the UFS combined aerosol and composition forecasts at ESRL and EMC during years 2 and 3.

Detailed tasks, milestones, and work load are outlined below.

Year 1:

- Global anthropogenic trace gas emission estimates will be obtained from the Community Emissions Data System (CEDS)[19] and used to replace the existing EDGAR-HTAP[20] emissions currently used in FV3GFS-RAQMSCHEM. **(Pierce, Lenzen, McKeen, Frost)**
- Biogenic emissions from land vegetation will be predicted by algorithms driven by FV3 meteorology constrained by the NGGPS land surface model processes and satellite-

derived vegetation phenology. The Model of Emissions of Gases and Aerosols from Nature (MEGAN)[21] and the Biogenic Emission Inventory System (BEIS)[22] will both be considered for replacement of the existing simple temperature dependent biogenic emissions used in FV3GFS-RAQMSCHEM. **(Pierce, Lenzen, McKeen, Frost)**

- Wildfire emissions will be derived from near-real-time satellite detections of fire locations and fire radiative power, along with off-line information about fuel loading and emissions speciation, and coupled to algorithms using FV3-predicted meteorology to model fire plume rise. The Quick Fire Emissions Dataset (QFEDV2)[23], High Resolution Rapid Refresh-Smoke (HRRR-Smoke)[24] , and Blended Global Biomass Burning Emissions Product from MODIS, VIIRS and Geostationary Satellites (GBBEPx, https://www.ospo.noaa.gov/Products/land/gbbepx/docs/GBBEPx_ATBD.pdf) biomass burning emissions will each be considered for replacement the existing biome and severity based wildfire emissions[25] used in FV3GFS-RAQMSCHEM **(Pierce, Lenzen, McKeen, Grell)**

Year 2:

- Retrospective experiments evaluating the impact of LBC from the combined FV3GFS aerosol (GSDCHEM) and composition (RAQMSCHEM) forecasts on regional NAM-CMAQ forecasts will be conducted during the 2019 NASA/NOAA FIREX-AQ field campaign (https://www.esrl.noaa.gov/csd/projects/firex/science.html). Results of the experiments will be evaluated using FIREX-AQ satellite, airborne, and ground based measurements. **(Pierce, Lenzen, McKeen, Lee)**
- We will port RAQMSCHEM to the ESRL HPC system and benchmark the real-time combined FV3 aerosol and composition forecasts during the period of most significant long-range transport (Spring 2020). Combined FV3 composition and aerosol forecasts will be evaluated using ground based ozone and PM2.5 measurements from the US EPA AirNOW network. **(Pierce, Lenzen, McKeen, Grell)**

Year 3:

- We will focus on real-time assessment of the impact of LBC from the combined FV3GFS aerosol (GSDCHEM) and composition (RAQMSCHEM) forecasts on regional NAM-CMAQ forecasts. Results of the real-time LBC experiments will be evaluated using ground based ozone and PM2.5 measurements from the US EPA AirNOW network, which is used to evaluate the operational NAM-CMAQ forecasts. **(All)**
- We will begin transitioning the combined GSDCHEM (aerosol) RAQMSCHEM (trace gas) capability to EMC for parallel testing and use within the NAQFC. (**All**)

1.5 Key Milestones

A milestone chart is provided for each of the three proposed years. The project milestone completion dates are listed in the table below.

Milestone	Description	Completion Date
1	Anticipated Project Start	June 01, 2019
2	Port and test Community Emissions Data System (CEDS) to S4	August 31, 2019
3	Complete CEDS emissions implementation in RAQMSCHEM	September 30, 2019
4	Port and test MEGAN and BEIS biogenic emissions module to S4	December 31, 2019
5	Complete biogenic emissions implementation in RAQMSCHEM	January 15, 2020
6	Port and test QFEDV2, HRRR-Smoke and GBBEPx wildfire emissions	April 15, 2020
7	Complete wildfire emissions implementation in RAQMSCHEM	May 31, 2020
8	Begin retrospective NAM-CMAQ/FV3 composition and aerosol LBC experiments	June 01, 2020
9	Complete evaluation of retrospective NAM-CMAQ RAQMSCHEM ozone and GSDCHEM aerosol LBC experiments	October 31, 2020
10	Begin porting and testing of real-time RAQMSCHEM on ESRL HPC	November 01, 2020
11	Begin real-time evaluation of combined FV3 RAQMSCHEM/GSDCHEM forecasts	March 01, 2021
12	Complete real-time evaluation of combined FV3 RAQMSCHEM and GSDCHEM forecasts	May 31, 2021
13	Begin real-time evaluation of NAM-CMAQ with FV3 RAQMSCHEM /GSDCHEM LBC forecasts	June 01, 2021
14	Complete real-time evaluation of NAM-CMAQ with FV3 RAQMSCHEM/GSDCHEM LBC forecasts	September 30, 2021
15	Begin transitioning the combined GSDCHEM RAQMSCHEM capability to EMC for parallel testing	October 01, 2021
16	Complete transition of the combined GSDCHEM RAQMSCHEM capability to EMC	February 28, 2022
17	Begin real-time evaluation of ARL Parallel NAM-CMAQ with FV3 RAQMSCHEM /GSDCHEM LBC forecasts	March 01, 2022
18	Complete real-time evaluation of ARL Parallel NAM-CMAQ with FV3 RAQMSCHEM /GSDCHEM LBC forecasts	May 31, 2022

2.0 Data Management Plan

We expect two categories of data to be generated during the course of research.

- Preliminary data: Data that are generated during the scientific development and that is not needed to support the results and conclusions of the research.
- Final data: Data that are the necessary to support the results and conclusions of the research and that represent the final scientific understanding of the research.

Preliminary data will not be shared or preserved. The cost to document, quality control, preserve and share what could be many incremental versions of calculations or results is judged to outweigh the potential benefit.

Final data for this project will be preserved and shared. Larger data sets will be arranged to be archived to tape at SSEC. Smaller data sets (e. g., those easily provided via ftp or as email attachments) will be maintained by the PI or publishing researcher. Data access instructions will be provided in publications or final report for the project. Retention will be for no less than 5 years following the final report or publication.
Smaller datasets required to reproduce figures, tables and other results presented in publications will be made available as supplementary material maintained by the publisher if possible. If the publisher is unable to provide this service, we will archive these data at SSEC and access instructions will be provided in the publication.

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4.0 Curriculum Vitae

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PhD, Meteorology, University of Wisconsin-Madison, 1988
BS, Physics, University of Wisconsin-River Falls, 1982
BS, Mathematics, University of Wisconsin-River Falls, 1982

Work History

10/18-Present	Academic Program Director, Space Science and Engineering Center, University of Wisconsin-Madison
05/07-09/18	Physical Scientist, Advanced Satellite Products Branch, NOAA/NESDIS Center for Satellite Applications and Research, Cooperative Institute for Meteorological Satellite Studies, Madison, WI
12/89-04/07	Research Scientist, Atmospheric Science Division, NASA Langley Research Center, Hampton VA

Honors & Awards

2003 NASA Exceptional Achievement Medal for outstanding contributions to the development of innovative techniques which enhance the scientific interpretation of airborne measurements of atmospheric constituents
2016 NOAA Administrator's Award for providing robust, real-time, simulated data of the next generation geostationary satellite imagers, reducing risk in post-launch operations.

Professional Experience
Dr. Pierce became the Director for the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison in October 2018 and is responsible for providing scientific vision and leadership, including leadership of large-scale research programs involving instrument development, data analysis technique development, participation in field campaigns, and new technology definition and implementation. Prior to his SSEC Director appointment he was a physical scientist at the National Oceanic and Atmospheric Administration (NOAA) and a senior research scientist at NASA. Dr. Pierce's research focuses on the development of capabilities to utilize satellite, airborne and ground based measurements to improve our understanding and ability to predict the physical and chemical processes within the Earth's atmosphere. Dr. Pierce has more than 22 years of experience in the design, development and execution of global atmospheric models. Dr. Pierce has more than 20 years of experience in chemical modeling and forecasting support for NASA, NOAA, and NSF field campaigns. Dr. Pierce has been actively involved in the NASA Applied Sciences Program, which focuses on transitioning NASA satellite data sets to other agencies Decision Support Systems.

Pierce Publications (Last 3 Years, Overall 101 refereed, h-index=28)

2018

Judd Laura M., Al-Saadi Jassim A., Valin Lukas C., **Pierce R. Bradley**, Yang Kai, Janz Scott J., Kowalewski Matthew G., Szykman James J., Tiefengraber Martin, Mueller Moritz, The Dawn of Geostationary Air Quality Monitoring: Case Studies From Seoul and Los Angeles, Frontiers in Environmental Science, Vol 6, 2018, DOI=10.3389/fenvs.2018.00085

Kabatas, B.; **Pierce, R.B**.; Unal, A.; Rogal, M.J. and Lenzen, A. April 2008 Saharan dust event: its contribution to PM10 concentrations over the Anatolian Peninsula and relation with synoptic conditions. Science of the Total Environment, Volume 633, 2018, pp.317-328. Reprint # 8308.

Liang, C.K.; West, J.J.; Silva, R.A.; Bian, H.S.; Chin, M.; Davila, Y.; Dentener, F.J.; Emmons, L.; Flemming, J.; Folberth, G.; Henze, D.; Im, U.; Jonson, J.E.; Keating, T.J.; Kucsera, T.; Lenzen, A.; Lin, M.Y.; Lund, M.T.; Pan, X.H.; Park, R.J.; **Pierce, R.B.**; Sekiya, T.; Sudo, K. and Takemura, T. HTAP2 multi-model estimates of premature human mortality due to intercontinental transport of air pollution and emission sectors. Atmospheric Chemistry and Physics, Volume 18, Issue 14, 2018, pp.10497-10520.

Langford, A. O.; Alvarez, R. J. III; Brioude, J.; Evan, S.; Iraci, L. T.; Kirgis, G.; Kuang, S.; Leblanc, T.; Newchurch. M. J.; **Pierce, R. B.**; Senff, C. J. and Yates, E. L. Coordinated profiling of stratospheric intrusions and transported pollution by the Tropospheric Ozone Lidar Network (TOLNet) and NASA Alpha Jet experiment (AJAX): Observations and comparison to FYSPLIT, RAQMS, and FLEXPART. Atmospheric Environment, Volume 174, 2018, pp.1-14.

2017

Pan, L. L.; Atlas, E. L.; Salawitch, R. J.; Honomichl, S. B.; Bresch, J. F.; Randel, W. J.; Apel, E. C.; Hornbrook, R. S.; Weinheimer, A. J.; Anderson, C. D.; Andrews, S. J.; Baidar, S.; Beaton, S. P.; Campos, T. L.; Carpenter, L. J.; Chen, D.; Dix, B.; Donets, V.; Hall, S. R.; Hanisco, T. F.; Homeyer, C. R.; Huey, L. G.; Jensen, J. B.; Kaser, L.; Kinnison, D. E.; Koenig, T. K.; Lamarque, J.-F.; Liu, C.; Luo, J.; Luo, Z. J.; Montzka, D. D.; Nicely, J. M.; **Pierce, R. B**.; Riemer, D. D.; Robinson, T.; Romashkin, P.; Saiz-Lopez, A.; Schauffler, S.; Shieh, O.; Stell, M. H.; Ullmann, K.; Vaughan, G.; Volkamer, R. and Wolfe, G. The Convective Transport of Active Species in the Tropics (CONTRAST) experiment. Bulletin of the American Meteorological Society, Volume 90, Issue 1, 2017, 106–128.

Kuang, Shi; Newchurch, Michael J.; Johnson, Matthew S.; Wang, Lihua; Burris, John; **Pierce, Robert B.**; Eloranta, Edwin W.; Pollack, Ilana B.; Graus, Martin; de Gouw, Joost; Warneke, Carsten; Ryerson, Thomas B.; Markovic, Milos Z.; Holloway, John S.; Pour-Blazar, Arastoo; Huang, Guanyu; Liu, Xiong and Feng, Nan. Summertime tropospheric ozone enhancement associated with a cold front passage due to stratosphere-to-troposphere transport and biomass burning: Simultaneous ground-based lidar and airborne measurements. Journal of Geophysical Research-Atmospheres, Volume 122, Issue 2, 2017, pp.1293-1311.

Yates, E. L., Johnson, M. S., Iraci, L. T., Ryoo, J.-M., **Pierce, R. B**., Cullis, P. D., … Tanaka, T. (2017). An assessment of ground level and free tropospheric ozone over California and Nevada. Journal of Geophysical Research: Atmospheres, 122, 10,089–10,102, https://doi.org/10.1002/2016JD026266

Langford, A. O.; Alvarex, R. J. II; Brioude, J.; Fine, R.; Gustin, M. S.; Lin, M. Y.; Marchbanks, R. D.; **Pierce, R. B**.; Sandberg, S. P.; Senff, C. J.; Weickmann, A. M., and Williams, E. J. Entrainment of stratospheric air and Asian pollution by the convective boundary layer in the southwestern US. Journal of Geophysical Research-Atmospheres v.122, no.2, 2017, pp1312-1337.

Huang, M., Carmichael, G. R., **Pierce, R. B.,** Jo, D. S., Park, R. J., Flemming, J., Emmons, L. K., Bowman, K. W., Henze, D. K., Davila, Y., Sudo, K., Jonson, J. E., Tronstad Lund, M., Janssens-Maenhout, G., Dentener, F. J., Keating, T. J., Oetjen, H., and Payne, V. H. (2017), Impact of intercontinental pollution transport on North American ozone air pollution: an HTAP phase 2 multi-model study, Atmos. Chem. Phys., 17, 5721-5750, https://doi.org/10.5194/acp-17-5721-2017, 2017.

P. Zoogman, X. Liu, R.M. Suleiman, W.F. Pennington, D.E. Flittner, J.A. Al-Saadi, B.B. Hilton, D.K. Nicks, M.J. Newchurch, J.L. Carr, S.J. Janz, M.R. Andraschko, A. Arola, B.D. Baker, B.P. Canova, C. Chan Miller, R.C. Cohen, J.E. Davis, M.E. Dussault, D.P. Edwards, J. Fishman, A. Ghulam, G. González Abad, M. Grutter, J.R. Herman, J. Houck, D.J. Jacob, J. Joiner, B.J. Kerridge, J. Kim, N.A. Krotkov, L. Lamsal, C. Li, A. Lindfors, R.V. Martin, C.T. McElroy, C. McLinden, V. Natraj, D.O. Neil, C.R. Nowlan, E.J. O′Sullivan, P.I. Palmer, **R.B. Pierce**, M.R. Pippin, A. Saiz-Lopez, R.J.D. Spurr, J.J. Szykman, O. Torres, J.P. Veefkind, B. Veihelmann, H. Wang, J. Wang, K. Chance (2017), Tropospheric emissions: Monitoring of pollution (TEMPO), In Journal of Quantitative Spectroscopy and Radiative Transfer, Volume 186, 2017, Pages 17-39, ISSN 0022-4073, https://doi.org/10.1016/j.jqsrt.2016.05.008.

Kaldunski, Ben; **Pierce, Brad** and Holloway, Tracey. When stratospheric ozone hits ground-level regulation: Exceptional events in Wyoming. Bulletin of the American Meteorological Society, Volume 98, Issue 5, 2017, pp.889-892.

2016

Baukabara, Sid A.; Zhu, Tong; Tolman, Hendrik L.; Lord, Steve; Goodman, Steven; Atlas, Robert; Goldberg, Mitch; Auligne, Thomas; **Pierce, Bradley**; Cucurull, Lidia; Zupanski, Milija; Zhang, Man; Moradi, Isaac; Otkin, Jason; Santek, David; Hoover, Brett; Pu, Zhaoxia; Zhan, Xiwu; Hain, Christopher; Kalnay, Eugenia; Hotta, Daisuke; Nolin, Scott; Bayler, Eric; Mehra, Avichal; Casey, Sean P. F.; Lindsey, Daniel; Grasso, Louie; Kumar, V. Krishna; Powell, Alfred; Xu, Jianjun; Greenwald, Thomas; Zajic, Joe; Li, Jun; Li, Jinliong; Li, Bin; Liu, Hicheng; Fang, Li; Wang, Pei and Chen, Tse-Chen. S4: An O2R/R2O infrastructure for optimizing satellite data utilzation in NOAA numerical modeling systems. A step toward bridging the gap between research and operations. Bulletin of the American Meteorological Society, Volume 97, Issue 12, 2016, 2359–2378.

Saide, P. E., G. Thompson, T. Eidhammer, A. M. da Silva, **R. B. Pierce**, and G. R. Carmichael (2016), Assessment of biomass burning smoke influence on environmental conditions for multi-year tornado outbreaks by combining aerosol-aware microphysics and fire emission constraints, J. Geophys. Res. Atmos., 121, doi:10.1002/2016JD025056.

Barbara Arvani, **R. Bradley Pierce**, Alexei I. Lyapustin, Yujie Wang, Grazia Ghermandi, Sergio Teggi (2016), Seasonal monitoring and estimation of regional aerosol distribution over Po valley, northern Italy, using a high-resolution MAIAC product, Atmos. Environ. 141, 106-121, http://dx.doi.org/10.1016/j.atmosenv.2016.06.037

Brunner, J., **Pierce, R. B.,** & Lenzen, A. (2016). Development and Validation of Satellite-Based Estimates of Surface Visibility. Atmospheric Measurement Techniques, 9(2), 409-422. [10.5194/amt-9-409-2016]

Miyazaki, Yuzo, Sean Coburn, Kaori Ono, David T. Ho, **R. Bradley Pierce**, Kimitaka Kawamura, Rainer Volkamer: Contribution of dissolved organic matter to submicron water-soluble organic aerosols in the marine boundary layer over the eastern equatorial Pacific. Atmospheric Chemistry and Physics 03/2016; DOI:10.5194/acp-2016-164

Pao Baylon, Daniel A Jaffe, **R Bradley Pierce**, Mae Sexauer Gustin: Interannual variability in baseline ozone and its relationship to surface ozone in the western U.S. Environmental Science & Technology 02/2016; DOI:10.1021/acs.est.6b00219

Daniel C. Anderson, Julie M. Nicely, Ross J. Salawitch, Timothy P. Canty, Russell R. Dickerson, Thomas F. Hanisco, Glenn M. Wolfe, Eric C. Apel, Elliot Atlas, Thomas Bannan, Stephane Bauguitte, Nicola J. Blake, James F. Bresch, Teresa L. Campos, Lucy J. Carpenter, Mark D. Cohen, Mathew Evans, Rafael P. Fernandez, Brian H. Kahn, Douglas E. Kinnison, Samuel R. Hall, Neil R.P. Harris, Rebecca S. Hornbrook, Jean-Francois Lamarque, Michael Le Breton, James D. Lee, Carl Percival, Leonhard Pfister, **R. Bradley Pierce**, Daniel D. Riemer, Alfonso Saiz-Lopez, Barbara J.B. Stunder, Anne M. Thompson, Kirk Ullmann, Adam Vaughan, Andrew J. Weinheimer: A pervasive role for biomass burning in tropical high ozone/low water structures. Nature Communications 01/2016; 7. DOI:10.1038/ncomms10267

Greenwald, Thomas J.; **Pierce, R. Bradley**; Schaack, Todd; Otkin, Jason; Rogal, Marek; Bah, Kaba; Lenzen, Allen; Nelson, Jim; Li, Jun and Huang, Hung-Lung. Real-time simulation of the GOES-R ABI for user readiness and product evaluation. Bulletin of the American Meteorological Society, Volume 97, Issue 2, 2016, pp.245-261.

5.0 Current and Pending

R. Bradley Pierce

<u>Current Awards</u>

Title: Tropospheric Emissions: Monitoring of Pollution (TEMPO) Science Team
Agency: NASA
Award PI: Pierce, R Bradley
Role: PI
Commitment (months): 0.6 Cal
Total Award Amount: $203,586
Period of Performance: 10/1/13-09/31/21

Title: CrIS/OMPS and TES ozone retrievals in support of the FIREX intensive campaign
Agency: NOAA
Award PI: Bowman, Kevin (JPL)
Role: Co-PI
Commitment (months): 1.2 Cal
Total Award Amount: $606,390
Period of Performance: 10/1/17 - 9/31/19

Title: A Satellite Constrained Meteorological Modeling Platform for LADCO States SIP Development
Agency: NASA
Award PI: Otkin, Jason
Role: Collaborator
Commitment (months): 1.2 Cal
Total Award Amount: $798,841
Period of Performance: 10/1/18 - 9/31/21

Title: CIMSS Activities on Supporting NESDIS Strategic Planning and Observing Systems Exploitation
Agency: NOAA
Award PI: Ackerman, Steve
Role: Collaborator
Commitment (months): 1.2 Cal
Total Award Amount: $350,000
Period of Performance: 08/01/18-06/30/19

<u>Pending awards</u>

None

Allen Lenzen

Current Awards

Title: CrIS/OMPS and TES ozone retrievals in support of the FIREX intensive campaign
Agency: NOAA
Award PI: Bowman, Kevin (JPL)
Role: Co-I
Commitment (months): 3.6 Cal
Total Award Amount: $606,390
Period of Performance: 10/1/17 - 9/31/19

Title: CIMSS Activities on Supporting NESDIS Strategic Planning and Observing Systems Exploitation
Agency: NOAA
Award PI: Ackerman, Steve
Role: Co-I
Commitment (months): 6.0 Cal
Total Award Amount: $350,000
Period of Performance: 08/01/18-06/30/19

Pending awards

None

Stuart McKeen

Funded proposal to 2018-2020 call of the JPSS Proving Ground/Risk Reduction Program: Characterization and Application of JPSS Products in Biomass Burning Studies. PI: Gregory Frost, Co-Is: Stuart McKeen, Mariusz Pagowski. Award period: October 2018 – September 2021. Total award: $557,650. Dr. McKeen contributes 25% effort to this project.

Statement of Work to NWS/NCEP for NOAA NGGPS Aerosols and Chemistry: Project Team: G. Grell, R. Ahmadov, R. Saylor, P. Lee, D. Tong, G. Frost, S. McKeen, L. Zhang. April 2018 – March 2019. Award to CSD: $150,000. Dr. McKeen contributes 50% effort to this project.

Funded proposal to NOAA OWAQ/NWS/NGGPS: Developing a Unified Online Air Quality Forecasting System Based on CMAQ and NGGPS. FY2016-2018. Award to CSD in FY18: $44,500. Dr. McKeen contributes 17% effort to this project.

Budget Justification

Requested Funding:

	Year 1	**Year 2**	**Year 3**
SSEC:	$186,165 (FY19)	$174,194 (FY20)	$174,411 (FY21)
CIRES:	$ 61,035 (FY19)	$ 74,763 (FY20)	$ 74,924 (FY21)
Total:	$247,200 (FY19)	$248,957 (FY20)	$249,335 (FY21)

NOAA Collaborators Georg Grell, Greg Frost, and Pius Lee will provide 0.1FTE/year of in-kind support for this effort.

The UW-Madison SSEC budget includes funding to support salary and fringe benefits for PI Brad Pierce at 0.10 FTE for years 1-3, salary and fringe benefits for Co-I Allen Lenzen at 0.40, 0.25, and 0.10 FTE for years 1-3, respectively and salary and fringe benefits for a UW-Madison SSEC Post-Doctoral student at 0.50, 0.75, and 1.00 FTE for years 1-3, respectively. SSEC Fringe is 33.3% of salary for Pierce and Lenzen and 20.0% of salary for Post-Doctoral Students. SSEC Indirect Cost is 54% in year 1 and 55% in year 2 and 3 based on modified total direct costs, indirect costs are only applied on the first $25k of a subaward. The UW-Madison SSEC budget also includes travel funds for 1 4-day trip to Boulder, CO for the PI to attend annual Project Status Reviews.

The CIRES budget includes funding to support salary and fringe benefits for Co-I Stuart Mckeen (ESRL/CIRES) at 2.75, 3.26, and 3.17 months per year for years 1-3, respectively and will be administered as a sub-award through UW-Madison. CIRES Fringe is 38.4% and the overhead is 26.0%

Travel Detail

1 Trip / 1 person / 4 days / Team Meeting - Boulder, CO				
	fares		subtotal	
Airfare	1	500	$500	
	# days	cost / day		
Hotel	3	199	$597	
Meals and Incidentals	3.5	66	$231	
Local Transportation-Madison	2	25	$50	
Transportation	4	55	$220	
				$1,598

Budget Details

		Year 1						
		1 June 2019 - 31 May 2020						
I.	Labor and Fringe Benefits		Hours	Rate	Salary	Fringe %	Fringe	Cost	Totals
	a)	PI - B. Pierce	180	105.56	$ 19,001	33.3%	$ 6,327	$ 25,328	
	b)	CoI - A. Lenzen	710	55.13	$ 39,142	33.3%	$ 13,034	$ 52,176	
	c)	Research Associate	890	30.92	$ 27,515	20.0%	$ 5,503	$ 33,018	
		Subtotal							$110,522
II.	Travel								
		1 Trip / 1 person / 4 days / Team Meeting - Boulder, CO						1,598	
									1,598
III.	Subaward (< $25k)								25,000
IV.	University Indirect Cost at 54%								74,045
V.	Subaward (>$25)								36,035
		YEAR 1 TOTAL							$247,200

		Year 2							
		1 June 2020 - 31 May 2021							
I.	Labor and Fringe Benefits		Hours	Rate	Salary	Fringe %	Fringe	Cost	Totals
	a)	PI - B. Pierce	180	108.73	$ 19,571	33.3%	$ 6,517	$ 26,088	
	b)	CoI - A. Lenzen	445	56.78	$ 25,269	33.3%	$ 8,415	$ 33,684	
	c)	Research Associate	1335	31.84	$ 42,511	20.0%	$ 8,502	$ 51,013	
		Subtotal							$110,785
II.	Travel								
		1 Trip / 1 person / 4 days / Team Meeting - Boulder, CO						1,598	
									1,598
III.	Subaward (< $25k)								0
III.	University Indirect Cost at 55%								61,811
V.	Subaward (>$25)								74,763
		YEAR 2 TOTAL							$248,957

		Year 3						
		1 June 2021 - 31 May 2022						
I.	Labor and Fringe Benefits		Hours	Rate	Salary	Fringe %	Fringe	Cost	Totals
	a)	PI - B. Pierce	180	111.99	$ 20,158	33.3%	$ 6,713	$ 26,871	
	b)	CoI - A. Lenzen	180	58.49	$ 10,528	33.3%	$ 3,506	$ 14,034	
	c)	Research Associate	1779	32.80	$ 58,350	20.0%	$ 11,670	$ 70,020	
		Subtotal							$110,925
II.	Travel								
		1 Trip / 1 person / 4 days / Team Meeting - Boulder, CO						1,598	
									1,598
III.	Subaward (< $25k)								0
III.	University Indirect Cost at 55%								61,888
V.	Subaward (>$25)								74,924
		YEAR 3 TOTAL							$249,335

		Budget Summary						
		Year 1 - 3						
I.	Labor and Fringe Benefits		Hours	Salary	Fringe %	Fringe	Cost	Totals
	a)	PI - B. Pierce	540	58,730	33.3%	19,557	$ 78,287	
	b)	CoI - A. Lenzen	1335	74,939	33.3%	24,955	$ 99,894	
	c)	Research Associate	4004	128,376	20.0%	25,675	$ 154,051	
		Subtotal						$332,232
II.	Travel							
		Year 1					1,598	
		Year 2					1,598	
		Year 3					1,598	
								4,794
III.	Subaward (< $25k)							25,000
III.	University Indirect Cost							197,744
V.	Subaward (>$25)							185,722
		TOTAL						**$745,492**

Subaward NOAA/ESRL

YEAR 1 BUDGET DETAILS for NOAA ESRL CSD/CIRES			
PERIOD OF PERFORMANCE: 6/1/2019-5/31/2020			
Personnel	**Months**	**Rate**	**Total**
Stuart McKeen			
Salary	2.75	$12,790	$35,204
Univ. of Colorado Fringe Benefits		37.60%	$13,237
TOTAL Salary + Fringe Benefits			$48,441
NOAA CI Overhead		26.00%	$12,594
Salary + Benefits + Overhead			$61,035

YEAR 2 BUDGET DETAILS for NOAA ESRL CSD/CIRES			
PERIOD OF PERFORMANCE: 6/1/2020-5/31/2021			
Personnel	**Months**	**Rate**	**Total**
Stuart McKeen			
Salary	3.26	$13,174	$42,997
Univ. of Colorado Fringe Benefits		38.00%	$16,339
TOTAL Salary + Fringe Benefits			$59,336
NOAA CI Overhead		26.00%	$15,427
Salary + Benefits + Overhead			$74,763

YEAR 3 BUDGET DETAILS for NOAA ESRL CSD/CIRES			
PERIOD OF PERFORMANCE: 6/1/2021-5/31/2022			
Personnel	**Months**	**Rate**	**Total**
Stuart McKeen			
Salary	3.17	$13,569	$42,965
Univ. of Colorado Fringe Benefits		38.40%	$16,499
TOTAL Salary + Fringe Benefits			$59,464
NOAA CI Overhead		26.00%	$15,460
Salary + Benefits + Overhead			$74,924

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN: 1396006492A1

ORGANIZATION:

University of Wisconsin - Madison,
Extension and System

21 North Park Street
Suite 6401

Madison, WI 53715

DATE:10/19/2018

FILING REF.: The preceding agreement was dated 05/14/2018

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: INDIRECT COST RATES

RATE TYPES: FIXED FINAL PROV. (PROVISIONAL) PRED. (PREDETERMINED)

	EFFECTIVE PERIOD				
TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
FINAL	07/01/2017	06/30/2018	53.00	On Campus	Organized Research
PRED.	07/01/2018	06/30/2019	54.00	On Campus	Organized Research
PRED.	07/01/2019	06/30/2021	55.00	On Campus	Organized Research
PRED.	07/01/2021	06/30/2022	55.50	On Campus	Organized Research
PRED.	07/01/2017	06/30/2022	53.00	On Campus	Instruction
PRED.	07/01/2017	06/30/2022	38.00	On Campus	Public Service
PRED.	07/01/2017	06/30/2019	29.50	On Campus	Ext. Public Service (1)
PRED.	07/01/2017	06/30/2019	37.00	On Campus	Primate Ctr Core Grant (2)
PRED.	07/01/2019	06/30/2021	38.00	On Campus	Primate Ctr Core Grant (2)
PRED.	07/01/2021	06/30/2022	38.50	On Campus	Primate Ctr Core Grant (2)
PRED.	07/01/2017	06/30/2022	26.00	Off Campus	All Programs

ORGANIZATION: University of Wisconsin - Madison, Extension and System

AGREEMENT DATE: 10/19/2018

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
PROV.	07/01/2022	Until Amended			Use same rates and conditions as those cited for fiscal year ending June 30, 2022.

*BASE

Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials and supplies, services, travel, and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, participant support costs and the portion of each subaward in excess of $25,000. Other items may only be excluded when necessary to avoid a serious inequity in the distribution of indirect costs, and with the approval of the cognizant agency for indirect costs.

(1) Effective July 1, 2019, the University of Wisconsin Extension was transferred in part to the University of Wisconsin-Madison and in part to the University of Wisconsin System with University of Wisconsin-Madison acting as UW System's fiscal manager for grants, contracts, and other agreements.

(2) Wisconsin National Primate Research Center - See Section II - Special Remarks

ORGANIZATION: University of Wisconsin - Madison, Extension and System

AGREEMENT DATE: 10/19/2018

SECTION I: FRINGE BENEFIT RATES**

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
FIXED	7/1/2017	6/30/2018	35.00	All	(1)
FIXED	7/1/2017	6/30/2018	44.60	All	(2)
FIXED	7/1/2017	6/30/2018	23.00	All	(3)
FIXED	7/1/2017	6/30/2018	22.20	All	(4)
FIXED	7/1/2017	6/30/2018	16.50	All	(5)
FIXED	7/1/2017	6/30/2018	8.60	All	(6)
FIXED	7/1/2017	6/30/2018	6.00	All	(7)
FIXED	7/1/2017	6/30/2018	3.20	All	(8)
FIXED	7/1/2018	6/30/2019	33.30	All	(1)
FIXED	7/1/2018	6/30/2019	42.50	All	(2)
FIXED	7/1/2018	6/30/2019	21.00	All	(3)
FIXED	7/1/2018	6/30/2019	20.00	All	(4)
FIXED	7/1/2018	6/30/2019	14.70	All	(5)
FIXED	7/1/2018	6/30/2019	11.50	All	(6)
FIXED	7/1/2018	6/30/2019	13.60	All	(7)
FIXED	7/1/2018	6/30/2019	3.10	All	(8)

PROV.	7/1/2019	6/30/2022	Use same rates and conditions as those cited for fiscal year ending June 30, 2019.

** DESCRIPTION OF FRINGE BENEFITS RATE BASE:

Salaries and wages of faculty and staff including vacation, holiday and sick leave pay and other paid absences of only the faculty and staff. Rate does not apply to student employees, research or teaching assistants.

(1) Regular Faculty and Academic Staff
(2) University and UWEXT Permanent Staff
(3) Research Assistants, Project Assistants, Teaching Assistants, Pre-Doc Fellows and/or Trainees
(4) Research Associates and Grad Interns
(5) Post-Doc Fellows and/or Trainees
(6) Limited Term Employees (LTE's)
(7) Ad Hoc Program Specialists, Undergraduate Assistants and Undergraduate Interns
(8) Student Hourly Employees

Fringe Benefit rates are combined rates for Madison and Milwaukee Campuses and are applied to both the campuses. These Fringe Benefit rates are also included on the University of Wisconsin, Milwaukee rate agreement.

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:

The fringe benefits are charged using the rate(s) listed in the Fringe Benefits Section of this Agreement. The fringe benefits included in the rate(s) are listed below.

TREATMENT OF PAID ABSENCES

Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims are not made for the cost of these paid absences.

OFF-CAMPUS DEFINITION: For all activities performed in facilities not owned by the institution or in facilities to which rent is directly allocated to the project(s) the off-campus rate will apply. Grants or contracts will not be subject to more than one F&A cost rate. If more than 50% of a project is performed off-campus, the off-campus rate will apply to the entire project.

FRINGE BENEFITS:

FICA
Retirement
Disability Insurance
Worker's Compensation
Life Insurance
Unemployment Insurance
Health Insurance
Severance Allowance
ERA Administration
Income Continuation Insurance

Primate Center Rates:

The Wisconsin National Primate Research Center (WNPRC) has two federally recognized rates. The Office of Research Infrastructure Programs (ORIP) Core Grant rate (A-Rate) and the Non-Core Federal Rate which is the sum of the ARate and the WNPRC specific F&A Expenses (B-rate).

Fiscal Year	A-Rate	B-Rate	Total (Non-Core Federal Rate)
2018	37.0%	16.0%	53.0%
2019	37.0%	17.0%	54.0%
2020	38.0%	17.0%	55.0%
2021	38.0%	17.0%	55.0%
2022	38.5%	17.0%	55.5%

Your next fringe benefit proposal based on actual costs for the fiscal year ending 06/30/2018 is due in our office by 12/31/2018.

Your next F&A proposal based on actual costs for the fiscal year ending 06/30/2021 is due in our office by 12/31/2021.

SECTION III: GENERAL

A. LIMITATIONS:

The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted: such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:

This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:

If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:

The rates in this Agreement were approved in accordance with the authority in Title 2 of the Code of Federal Regulations, Part 200 (2 CFR 200), and should be applied to grants, contracts and other agreements covered by 2 CFR 200, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:

If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:	ON BEHALF OF THE FEDERAL GOVERNMENT:
University of Wisconsin - Madison, Extension and System	DEPARTMENT OF HEALTH AND HUMAN SERVICES
(INSTITUTION)	(AGENCY)
Kim Moreland	Arif M. Karim -S Digitally signed by Arif M. Karim -S DN: c=US, o=U.S. Government, ou=HHS, ou=PSC, ou=People, cn=Arif M. Karim -S, 0.9.2342.19200300.100.1.1=2000212895 Date: 2018.10.26 08:02:51 -05'00'
(SIGNATURE)	(SIGNATURE)
Kim Moreland	Arif Karim
(NAME)	(NAME)
Assoc. Vice Chancellor, Research Administration	Director, Cost Allocation Services
(TITLE)	(TITLE)
November 2, 2018	10/19/2018
(DATE)	(DATE) 7201

HHS REPRESENTATIVE: Matthew Dito

Telephone: (214) 767-3261

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 01/31/2019

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. NOAA/OAR/OWAQ	11.459	$	$	$ 247,200.00	$	$ 247,200.00
2. NOAA/OAR/OWAQ	11.459			248,957.00		248,957.00
3. NOAA/OAR/OWAQ	11.459			249,335.00		249,335.00
4.						
5. Totals		$	$	$ 745,492.00	$	$ 745,492.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total
	(1) NOAA/OAR/OWAQ	(2) NOAA/OAR/OWAQ	(3) NOAA/OAR/OWAQ	(4)	(5)
a. Personnel	$ 85,658.00	$ 87,351.00	$ 89,036.00	$	$ 262,045.00
b. Fringe Benefits	24,864.00	23,434.00	21,889.00		70,187.00
c. Travel	1,598.00	1,598.00	1,598.00		4,794.00
d. Equipment					
e. Supplies					
f. Contractual	61,035.00	74,763.00	74,924.00		210,722.00
g. Construction					
h. Other					
i. Total Direct Charges (sum of 6a-6h)	173,155.00	187,146.00	187,447.00		$ 547,748.00
j. Indirect Charges	74,045.00	61,811.00	61,888.00		$ 197,744.00
k. TOTALS (sum of 6i and 6j)	$ 247,200.00	$ 248,957.00	$ 249,335.00	$	$ 745,492.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES				
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8.	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 745,492.00	$ 186,373.00	$ 186,373.00	$ 186,373.00	$ 186,373.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 745,492.00	$ 186,373.00	$ 186,373.00	$ 186,373.00	$ 186,373.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT				
(a) Grant Program	FUTURE FUNDING PERIODS (YEARS)			
	(b)First	(c) Second	(d) Third	(e) Fourth
16.	$	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$	$	$	$

SECTION F - OTHER BUDGET INFORMATION	
21. Direct Charges: 547748	22. Indirect Charges: 197744
23. Remarks:	

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